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CONSERVATION

Distribution and conservation status of Cuban palms (*Arecaceae*)

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Conflicts of Interest
The authors declare no conflict of interest.

Abstract
Palms are vital to tropical and subtropical ecosystems, with around 2,600 recognised species. In Cuba, their exceptional diversity and endemism, with 80 % of species endemic, underline their ecological importance. However, more than 50 % of the 71 species assessed are threatened, with 11 Critically Endangered and one Extinct (*Roystonea stellata*). Genera such as *Coccothrinax* and *Copernicia* are particularly notable, but face serious threats from invasive species, intensive agriculture, unregulated logging and climate change. These challenges are especially acute for microendemic species, many of which fall outside the National System of Protected Areas, which only covers 58.4 % of critical palm habitats. Taxonomic uncertainties and a paucity of genetic data further hamper conservation efforts. Although updates to IUCN criteria have refined conservation assessments, progress has been insufficient to reverse the decline. Effective conservation requires an integrated strategy that combines in situ and ex situ measures, specific plans for vulnerable species, and priority protection of underrepresented areas. Engaging local communities, government agencies, and stakeholders in implementing sustainable practices is equally essential. Molecular studies to resolve taxonomic ambiguities and accurately delimit species are critical to ensuring the long-term survival of these iconic species and their ecosystems. To safeguard the future of Cuban palms, which remain a cornerstone of Caribbean biodiversity, a holistic approach addressing both ecological and socioeconomic factors is needed.

Keywords: Endangered species, endemism, IUCN, plant formations, protected areas, red list, threats

Resumen
Las palmas son vitales para los ecosistemas tropicales y subtropicales, con alrededor de 2600 especies reconocidas. En Cuba, su excepcional diversidad y endemismo, con el 80 % de las especies endémicas, subrayan su importancia ecológica. Sin embargo, más del 50 % de las 71 especies evaluadas están amenazadas, con 11 en peligro crítico y una extinta (*Roystonea stellata*). Géneros como *Coccothrinax* y *Copernicia* son especialmente notables, pero se enfrentan a graves amenazas de especies invasoras, agricultura intensiva, tala no regulada y cambio climático. Estos retos son especialmente graves para las especies microendémicas, muchas de las cuales quedan fuera del Sistema Nacional de Áreas Protegidas, que sólo cubre el 58,4 % de los hábitats críticos de las palmas. Las incertidumbres taxonómicas y la escasez de datos genéticos dificultan aún más los esfuerzos de conservación. Aunque las actualizaciones realizadas conforme a los criterios de la UICN han perfeccionado las evaluaciones de conservación, los avances han sido insuficientes para invertir el declive. La conservación eficaz exige una estrategia integrada que combine medidas *in situ* y *ex situ*, planes específicos para las especies vulnerables y

protección prioritaria de las zonas infrarrepresentadas. Igualmente esencial es implicar a las comunidades locales, las entidades gubernamentales y las partes interesadas en la aplicación de prácticas sostenibles. Los estudios moleculares para resolver las ambigüedades taxonómicas y delimitar con precisión las especies son fundamentales para garantizar la supervivencia a largo plazo de estas especies emblemáticas y sus ecosistemas. Para salvaguardar el futuro de las palmeras cubanas, que siguen siendo una piedra angular de la biodiversidad caribeña, es necesario un planteamiento holístico que aborde tanto los factores ecológicos como los socioeconómicos.

Palabras clave: Especies amenazadas, endemismo, UICN, formaciones vegetales, áreas protegidas, lista roja, amenazas

Résumé

Les palmiers jouent un rôle essentiel dans les écosystèmes tropicaux et subtropicaux, avec environ 2 600 espèces reconnues. À Cuba, leur diversité et leur taux d'endémisme sont exceptionnels: 80 % des espèces sont endémiques, soulignant ainsi leur importance écologique. Cependant, plus de 50 % des 71 espèces évaluées sont menacées, dont 11 en danger critique et une déjà éteinte (*Roystonea stellata*). Des genres comme *Coccothrinax* et *Copernicia* sont particulièrement remarquables, mais ils sont confrontés à de graves menaces dues à la prolifération d'espèces envahissantes, à l'agriculture intensive, à l'exploitation forestière non réglementée et au changement climatique. Ces défis sont encore plus critiques pour les espèces microendémiques, dont beaucoup ne sont pas protégées par le Système National des Aires Protégées, qui ne couvre que 58,4 % des habitats critiques des palmiers. De plus, les incertitudes taxonomiques et le manque de données génétiques compliquent les efforts de conservation. Bien que les réévaluations récentes selon les critères de l'UICN aient affiné l'évaluation de leur état de conservation, les progrès restent insuffisants pour inverser leur déclin. Pour une conservation efficace, une stratégie intégrée est essentielle, combinant des mesures *in situ* et *ex situ*, des plans spécifiques pour les espèces les plus vulnérables et une protection prioritaire des zones sous-représentées dans les efforts de conservation. Il est également crucial d'impliquer les communautés locales, les autorités gouvernementales et d'autres parties prenantes dans la mise en œuvre de pratiques durables. Par ailleurs, les études moléculaires sont indispensables pour clarifier les ambiguïtés taxonomiques et définir précisément les espèces, garantissant ainsi leur survie à long terme. Sauvegarder l'avenir des palmiers cubains, piliers de la biodiversité caribéenne, nécessite une approche holistique prenant en compte à la fois les facteurs écologiques et socio-économiques.

Mots-clés: Espèces menacées, endémisme, UICN, formations végétales, aires protégées, liste rouge, menaces

INTRODUCCTION

With around 2,600 species distributed throughout tropical and subtropical regions, palms are among the most attractive and recognizable plants in the world, largely due to their economic importance, with numerous uses including food, timber, medicines, and cultural practices (Zona & al. 2007, Roncal & al. 2008, Rakotoarinivo & al. 2014). In their ecosystems, palms play a crucial role as a fundamental component of tropical ecosystems, particularly in rainforests (Roncal & al. 2008, Gardinier & Bachman 2016). Palms serve as habitat and food sources for animals such as birds and insects, as well as for local communities (Felger & Joyal 1999, Zona & al. 2007, Roncal & al. 2008). Undoubtedly, the high economic importance of these plants has led to years of unsustainable harvesting practices, resulting in population decline and extinction of many species due to overexploitation and habitat loss (Rakotoarinivo & al. 2014, Gardinier & Bachman 2016). These problems are especially severe for palm species with small and highly restricted populations, which is a common vulnerability within the *Arecaceae* family.

Assessing these threat levels allows the identification of conservation priorities, improves the effectiveness of protected areas, and guides conservation actions (Cosiaux & al. 2018). Palm species have been specifically identified as a priority group for completing a full global assessment of extinction risk by the IUCN Red List Committee (2013). According to Cosiaux & al. (2018), currently just 558 species of the world palm flora (21% of the family) have been officially assessed following IUCN criteria, despite palms being among the first groups of plants to receive attention regarding their state of endangerment, and having an action plan for conservation (Bernal & Galeano 2006). Therefore, a critical strategy for palm conservation is required to focus attention on conservation priorities, stimulate necessary actions, and raise public awareness.

Within the Caribbean, Cuba (the largest island) has greater palm biodiversity, not only in terms of species number but also in levels of endemism and group speciation (Zona & al. 2007, Roncal & al. 2008). Palms are, undoubtedly, among the most distinctive components of the Cuban flora. According to the latest checklist (Verdecia & Testé 2024), Cuba hosts 95 native palm taxa and 82 endemics, including numerous subspecies and hybrids. The Cuban Red List of 2016 (González-Torres & al. 2016) documented the conservation status of all Cuban palm species. However, recent years have seen updates and better adaptation to IUCN standards (IUCN 2019) regarding the conservation status of this group, along with changes in palm species delimitation, necessitating an update to the conservation status of Cuban palms based on these new developments.

While we have completed individual conservation assessments for all Cuban palm species, we lack a synthesized analysis that would provide a comprehensive understanding of the family's overall conservation status. Global analyses are vital for developing and proposing conservation measures for palms, as they help direct conservation resources to areas with the highest diversity and most threatened species. These spatial analyses also help identify Important Plant Areas (IPAs) for conservation. Therefore, this study aims

to update our understanding of the geographic and ecological distribution of Cuban palm species and review their conservation status.

MATERIALS AND METHODS

Study area

The Cuban archipelago is located in the western zone of the Caribbean Sea, between North and Central America. To the north it is bordered by the Strait of Florida, the Bahamas Channel and the Atlantic Ocean, to the east by the "Paso de los Vientos", to the south by the Caribbean Sea and to the west by the Strait of Yucatan. The Cuban archipelago is the largest in the Antilles, representing 47 % of the total area of the insular Caribbean. It has a total area of 110 922 km^2, and is made up of two main islands, Cuba (105 007 km^2) and the Isla de la Juventud (2 200 km^2), it also has 4 195 small islands and cays totaling 3715 km^2. The island's relief is predominantly flat, with four main mountainous areas: Guaniguanico, Guamuhaya, Sierra Maestra and Nipe-Sagua-Baracoa; those that only represent 35 % of the national territory. The maximum height is the Pico Turquino with 1 974 m a.s.l.

Cuba's climate is tropical, but it varies constantly, both due to the island's geographical location and the seasons, one dry (November-April) and the other rainy (May-October), with an average annual rainfall of 1 374 mm^3. The average temperature is around 25.5°C and the humidity is above 80 %. During the winter (November-February) there is the influence of cold air masses from North America and during the summer (June-October) the presence of tropical cyclones (Garrido & Kirkconnell 2010). The Cuban territory is divided into 168 municipalities and 15 provinces, in addition to a special municipality (Isla de la Juventud). The Cuban archipelago is characterized by constituting a complex mosaic of habitats and plant formations, which has influenced the high diversity of species that exists on the island. In Cuba, according to Capote & Berazaín (1984), there are 29 plant formations which can be grouped into five main categories: forests, scrub, herbaceous vegetation, complex vegetation of mogotes, and secondary vegetation.

Occurrence data

The geographic distribution was described using field, herbarium, and publication data. The first was obtained in expeditions carried out across the island between 2000 and 2022, in which the individuals were identified and georeferenced (Garmin GPS ±2 m). Herbarium data were taken from specimens deposited in B, BSC, BM, FTG, G, HAC, HAJB, JE, K, E, NY, P, S, and US (herbarium acronyms according to Thiers 2024+). The most possible precise location was estimated for the materials that did not have geographic coordinates. All the records of presence extracted from the herbaria were georeferenced in decimal coordinates using Google Maps (google.es/maps). All the occurrence points were carefully scrutinized in order to avoid point georeferentiation errors. Only the native species of *Arecaceae* were considered in all the analyses. Also, due to the taxonomic uncertainty of many subspecies and the doubtful origin of the hybrid, both were excluded from the analyses; considering only the species.

Distribution

The ecological distribution included the distribution by plant formation and the height above sea level. Plant formation was based on the classification proposed by Capote & Berazaín (1984), and was identified in the field and/or the labels of herbarium materials. The height above sea level was obtained from the digital elevation model (DEM) from the WorldClim database (Hijmans & al. 2005, http://www.worldclim.org), which has an approximate spatial resolution of 0.7883 km^2 per pixel. From DEM, the average, minimum, and maximum altitude values for each species were extracted using ArcGis 10.2 (Esri 2014).

The geographic range of each species was then quantified using two metrics, extent of occurrence (EOO) and area of occupancy (AOO); both of which can be used for assessments under criterion B (restricted range species). EOO was calculated as the minimum convex polygon that contained all known records for each species (IUCN 2019). AOO was calculated as the sum of the area of the squares occupied by each one of the species. The grid area was adjusted to 1 km^2 as recommended by the Cuban Plant Specialists Group, which represents a quarter of the recommended by the IUCN (2019). This area constitutes the adequate measurement in Cuban plants to indicate the appropriate habitat area associated with a record of presence. Both parameters (EOO and AOO) were calculated using the GeoCAT (Geospatial Conservation Assessment Tool) platform (Bachman & al. 2011). Based on the AOO and EOO values, micro-endemic species were defined as those that with AOO less than 2 km^2 or with a EPP value less than 10 km^2.

The representation within protected areas was determined by overlaying the geographic coordinates of presence records onto the digital map of protected areas (CNAP 2013, 2019). This analysis was performed using ArcGIS 10.2 (Esri 2014). For each species, we report the percentage of its area of occupancy included within protected areas. The term "locality" is used according to IUCN (2012a, 2019) definition - a distinctive geographic or ecological area in which a single threat event can rapidly affect all individuals of a taxon. Following UCN (2019) recommendations, localities were not defined for taxa where no potential threats were identified.

Two richness maps were done, the first one representing the richness for all palm species, and the second map only including the richness of threatened species. These maps were created using a Fishnet of 5x5 km (25 km^2) in ArcGis 10.2 (Esri 2014). Important areas for palm conservation in the country were also identified. These are areas in which the presence of threatened species could be prioritized. We obtained a map with key areas that included high palm richness combined with areas where threatened species occurred. For each grid cell, we calculated an index by combining two relative values: the proportion of total species present and the proportion of threatened species present. Each relative value was calculated by dividing the count in the grid cell by the respective total count. The final index is the sum of these two relative values.

IUCN Red List Conservation Assessments

The complete assessment of the conservation status of all native Cuban palm species was completed using the IUCN Red List categories and criteria version 3.1 (IUCN 2019). The assessments were independently reviewed and verified by the Red List Specialist of the Cuban Plant Specialist Group (GEPC), and submitted to the IUCN SIS Connected. Each species was classified according to one of the following IUCN categories: Extinct (EX), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), or Data Deficient (DD). Data from Cuban palms occurrence was used to summarize distribution, population size, and threats to species in order to apply the quantitative Red List criteria. During the assessment process, the threats for each species were classified according to the IUCN Threats Classification Scheme (version 3.2) (IUCN 2012). Details about the threats were obtained from expert field observations, specimen labels, and literature sources.

RESULTS

Distribution

All the results were based on a total of 71 species assessed (out of the 95 taxa known for Cuba which include hybrids and subspecies). The Cuban palms assessment is already submitted to the IUCN SIS Connect and will be published on the IUCN Red List webpage. The 71 palm species presented in Cuba are organized into 15 genera, being *Coccothrinax* with 32 species the richness genus of palms in Cuba; followed by *Copernicia* (15 species). The 80 % of the palm species are endemic to Cuba; which include all the *Copernicia´*s species and almost the species of *Coccothrinax* (except *C. fragans* and *C. argentata*). The genus *Hemithrinax*, with three species, represents an endemic genus from Cuba. The 96 % of the species are trees, with only two species that are classified as shrubs (*Acoelorrhaphe wrightii* and *Bactris cubensis*).

The coastal and sub-coastal xeromorphic thicket and the mesophyllous semideciduous forests were the type of vegetation more frequented by the Cuban palms. The number of species living in forest vegetation was quite similar to the one living in scrub vegetation (Fig. 1). *Coccothrinax miraguama* (with 11), *Roystonea regia* and *Copernicia yarey* (both with 9), were the palm species that live in most plant formations (Table 1). The Cuban palms were found in an average elevation of 140 m a.s.l. (range: 0 - 1 694 m a.s.l.). The genus *Coccothrinax* and *Copernicia* were found from the sea level until the 1 692 m a.s.l., being the differences between both group in the average elevation (*Coccothrinax*: 164 m a.s.l.; *Copernicia* 58 m a.s.l.).

Cuban palms are distributed throughout almost the entire Cuban territory (Fig. 2A). The areas with the larger diversity are essentially found in northeastern Cuba (Holguín-Guantánamo), South of central Cuba (Cienfuegos-Sancti Spíritus), and the western extreme of Cuba (Pinar del Río). When analyzing the distribution by the two large genera (*Coccothrinax* and *Copernicia*) the pattern is the same (data not shown). Mayarí (province Holguín) and Manatí (province Las Tunas) with 14 species each one, were the municipality with more species of palms (Fig. 3). A total of 18 palm species were considered as micro-endemic (AOO $\leq$ 2 km^2 or EPP $\leq$ 9 km^2), belonging 14 of them to the genus *Coccothrinax*.

A total of 120 important areas for Cuban palms were identified across the entire island (Fig. 4), more of them concentrated in northeastern Cuba. It is important to resalt the fact that 58.4 % of important areas were found outside the protected areas, mainly in the around of the city of Camagüey (central Cuba). The Protected Areas of Managed Resources Cuchillas del Toa (six) and Baconao (three), were the protected area which include more important areas for palms. Another seven protected areas, including for National Parks (Alejandro de Humboldt, Ciénaga de Zapata, La Mensura-Pilotos, and Viñales) included inside their limits two important areas for palms.

IUCN Red List Conservation Assessments

The conservation status was assessed for 71 palm species, resulting in 11 Critically Endangered (CR), 12 Endangered (EN), 13 Vulnerable (VU), 29 Least Concern (LC), 5 Data Deficient (DD) and one Extinct species (*Roystonea stellata*) (Table 2). The five species in DD it was due to its uncertain taxonomic identity. The 50.7 % of Cuban palms were found in one of the three threatened categories (CR, EN, VU). The percentage of species threatened rises to 65.6 % in the genus *Coccothrinax*. The three species of the endemic genus *Hemithrinax* were considered threatened. The Criteria B (geographic extension) was the most used (32 species) in order to evaluate the conservation status of Cuban palms, followed by criteria D (small population size) with six species. The areas with the highest richness of endangered species (CR, EN, VU) were concentrated in the same regions as the large diversity areas (northeastern Cuba, South of central Cuba, and the western extreme of Cuba (Fig. 2B). 10 from 17 micro-endemic species were considered in one of the threatened categories.

Only in nine species no evident threats were reported, and a total of 23 species were affected with five or more threats, being *Coccothrinax miraguama*, with nine, the palm with most threatened in Cuba. The major threatening processes for palms in Cuba were invasive species, agriculture and logging of associated species. The climatic change is affecting or will affect a total of 16 species. Concerning the endangered (CR, EN, VU) and micro-endemic palms, the main threats were felling of associated species and invasive species; which are the main threats of the entire family. The different threats per species can be found in the Table 1.

Regarding distribution within protected areas, 14 palm species are not covered by the National System of Protected Areas (SNAP, acronym in Spanish) (Fig. 5), eight of them considered as micro-endemic palms. The other species were found at least in one protected area, with 14 species covered by six or more protected areas. In the specific case of *Roystonea regia*, this species was found in 39 protected areas, but this number is underestimated due to their wide and under-recorded distribution. All recorded sites for eight species were within protected areas, and for another 18 species, more than half of their distribution was within protected areas (Table 1). The most important protected areas for Cuban palms are with 11 species

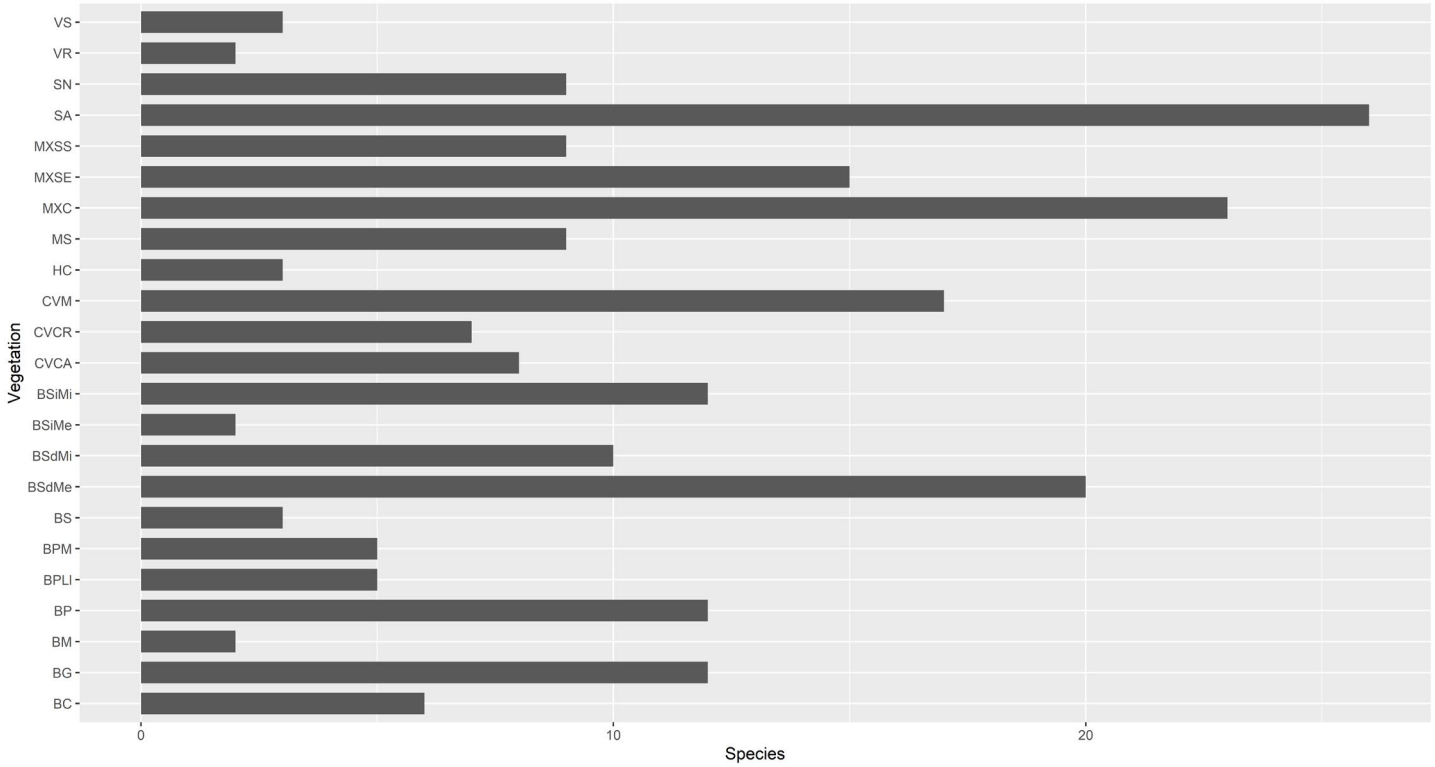

Figure 1. Number of species of Cuban palm species by plant formations. Anthropic savannas (SA), Coastal and subcoastal xeromorphic thicket (MXC), Gallery forest (BG), Low altitude rainforest (BPLl), Mesophyllous evergreen forest (BSiMe), Mesophyllous semidecidous forest (BSdMe), Microphyllous evergreen forest (BSiMi), Microphyllous semidecidous forest (BSdMi), Mogotes vegetation complex (CVM), Montane rainforests (BPM), Pine forest (BP), Rocky coasts vegetation complex (CVCR), Sandy coasts vegetation complex (CVCA), Secondary forest (BS), Seminatural savannas (SN), Swamp forest (BC), Herbaceous formations of swamps and marshes (HC), Xeromorphic subthorny thicket on serpentine (MXSS), Xeromorphic thorny thicket on serpentine (MXSE).

Cuchillas del Toa and Buenavista, and with 10 species Península de Zapata (the three are Managed Resources Protected Areas).

DISCUSION

The number of Cuban palm species varies between 80 to 90 taxa according to different works (Leiva 2006, Moya 2019, Henderson 2023, Verdecia & Testé 2024). This number changes depending on whether hybrids and different subspecies are included in the lists. Cuba represents an important biodiversity hotspot within the Caribbean for the family *Arecaceae*, which implies that more conservation efforts must be focused on Cuban palms. In the present work, we consider 71 species of palms reported in Cuba, which represent more than half of the species reported by Zona & al. (2007) for the West Indies. Jestrow & al. (2018) recognized 103 endemic species for Caribbean islands, which means that Cuba has 55% of all the endemic palms reported for the region. According to Plants of the World Online (POWO 2024+), the genus *Coccothrinax* includes 56 species, 32 of them (54%) live exclusively in Cuba. The genus *Copernicia* includes 22 species, 15 of them living exclusively in Cuba (72.7%). According to González-Torres & al. (2016), the complex geological formation of the Cuban island made it the origin and center of diversification for numerous plant genera such as *Buxus* (González-Gutiérrez & al. 2023), *Selaginella* (Sánchez 2017), *Antillanthus* (Fransisco-Ortega & al. 2008), and *Leptocereus* (Barrios 2020).

The distribution of Cuban palms is in concordance with the general distribution of Cuban flora richness reported by González-Torres & al. (2016). It is important to pay attention to the high number of palm important areas that are found outside protected areas, in which monitoring actions and conservation proposals must be carried out in order to protect our palms. But even inside the protected areas, we need to pay important attention to the zones identified as palm important areas, in order to concentrate the conservation efforts. The distributions presented in this work do not fully represent the actual ranges of Cuban palms. Several species, particularly those with wide distributions (e.g., *Roystonea regia*, *Pseudophoenix sargentii*, *Sabal maritima*, and *Thrinax radiata*), are underestimated. According to Gardinier & Bachman (2016) and Cosiaux & al. (2018), palms are generally under-collected by botanists due to their size and the difficulty of making good specimens in the field, especially by non-palm specialists. This problem implies that they are often under-represented in herbaria; but the absence of specimens from a site does not mean that the species is not present there (Gardinier & Bachman 2016). Cuba is not free of this problem; with few palm specialists and botanists in general, the number of palm records in Cuban herbaria and databases is much lower than expected.

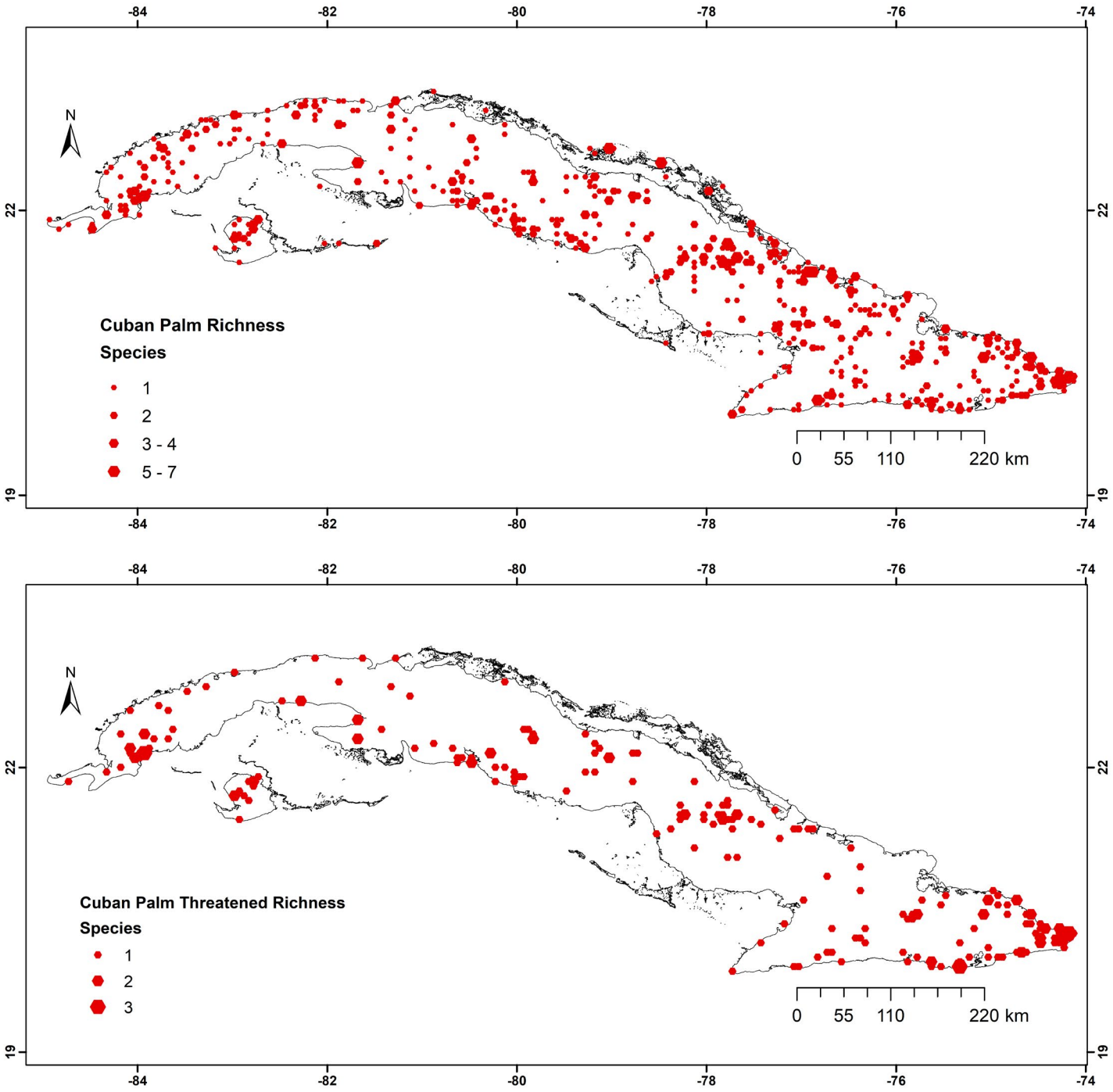

Figure 2. Species richness map of Cuban palm species. A: based on all the species; B: Based on endangered species (CR, EN, VU).

Additionally, in genera such as *Coccothrinax* and *Copernicia*, taxonomic identification can be challenging. Therefore, herbarium specimens are essential to validate species presence at specific locations. Even though palms are a complicated group to identify and collect, they are among the Cuban plants with more conservation analysis and efforts in the past (Zona & al. 2007, González-Torres & al. 2016, Jestrow & al. 2018). The current conservation analysis represents an update in the conservation analysis of the group, which takes into consideration the new evaluations made since the publication of the Cuban Red List (González-Torres & al. 2016). The biggest changes between the current analysis and those published by Zona & al. 2007 and González-Torres & al. (2016) are in the number of species considered, which changes the number of species in each conservation category. Zona & al. 2007 and González-Torres & al. (2016) considered 93 and 79 Cuban species, respectively. These differences in the number of species were due to recent taxonomic analyses made in the group (see: Henderson 2023, Verdecia & Testé 2024).

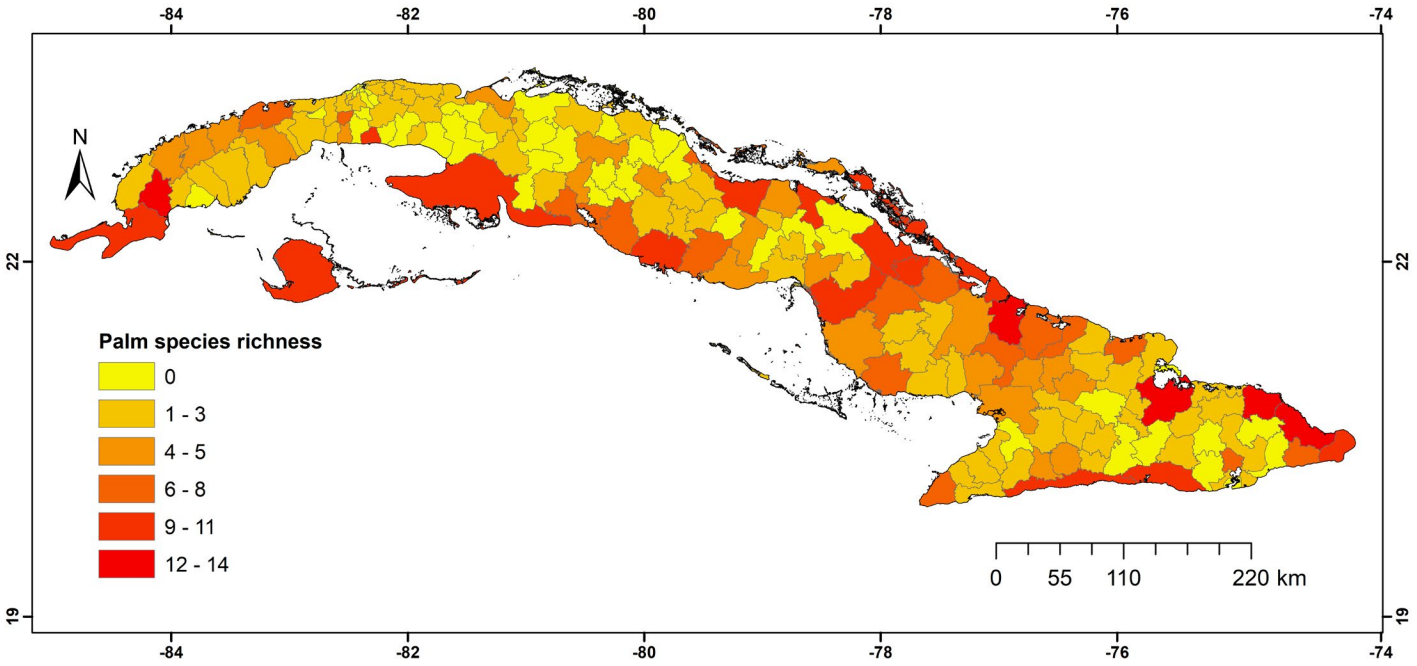

Figure 3. Number of species by municipality of Cuban palm species.

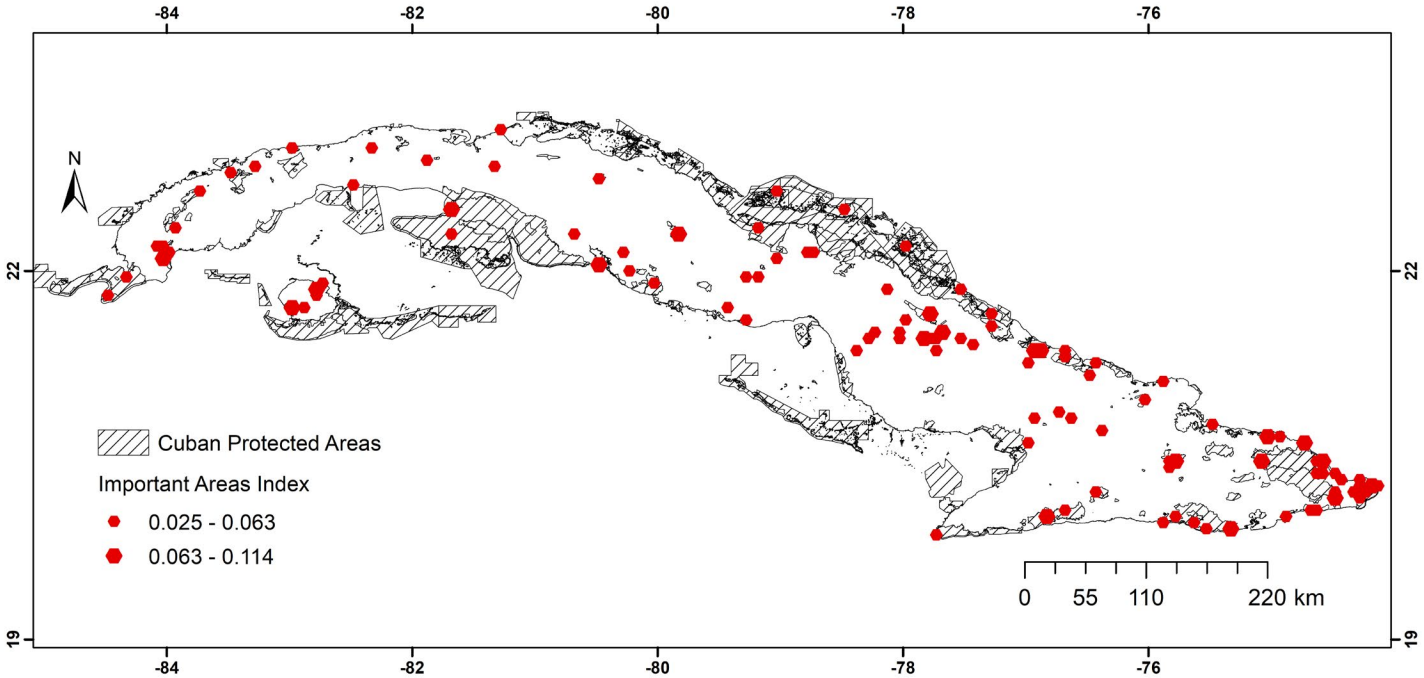

Figure 4. Important areas identified for Cuban palm species. Information is compared with the current protected areas system.

Most species in this study were assessed using Criterion B which, according to IUCN (2019), uses geographic range size and evidence of declining or fragmenting populations. Criterion B is suitable for estimating conservation status even when data is limited and the distribution of a species is only known from a few herbarium collections (Brummitt & al. 2008). However, this way of assessing species should not undermine the need for population studies to determine the current status and dynamics of populations.

The high percentage of endangered species, specifically in the genus *Coccothrinax*, represents a real and unsolved conservation problem. Many of these species are the same reported in 2007 and 2016 by Zona & al. (2007) and González-Torres & al. (2016), respectively. Definitely, in the last 20 years, despite the conservation efforts, we have not been able to improve the conservation status of Cuban palms. According to González-Torres & al. (2016), palms are among the most threatened plant groups in Cuba.

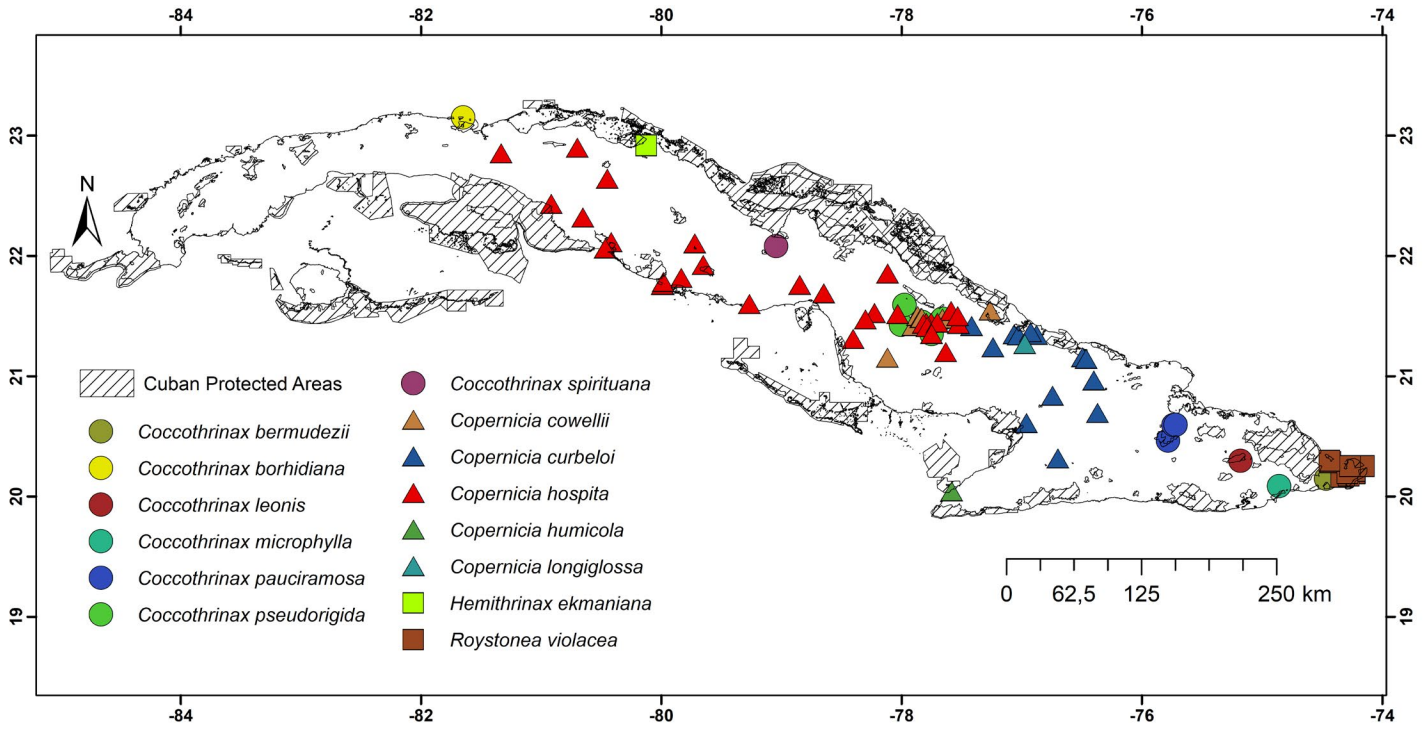

Figure 5. Cuban palm species not representing inside the Cuban system of protected areas.

When comparing results outside Cuba, the percentage of threatened palms on the island is higher than that reported for Paraguay (30%; Gauto & al. 2011), Colombia (18%), and Peru (20%) (Galeano & Bernal 2005). However, it is significantly lower than the 78% of threatened palms reported for Madagascar (Rakotoarinivo & al. 2014).

We want to highlight the case of *Roystonea stellata*, the only Cuban palm reported to be Extinct in the current analysis, which was already reported in the same category by Zona & al. (2007) and González-Torres & al. (2016). According to Zona & al. (2007) and Verdecia (2015), this palm was only known from the "Meseta de Maisí" in the eastern region of Guantánamo province. It was described from a single specimen by Brother León in 1943, but repeated explorations have failed to relocate it, even when photographs were distributed among local people of the area (Zona & al. 2007, Verdecia 2015).

Many Cuban palms are only located in a few places, which makes them considered micro-endemic species. These species were evaluated in a high percentage as threatened (Table 1). The conservation problem of the micro-endemic species is even more complicated for those six species that are not included inside any protected areas (Table 1). These species should be the priority of the ex-situ conservation programs in the Cuban botanical gardens, in order to ensure the long-term survival of the species. The phenomena of micro-endemism of Cuban palms were already reported by Zona & al. (2007), and by González-Torres & al. (2016) and Pillon & al. (2019) for the Cuban flora. Cosiaux & al. (2018) report that many Madagascar palms are only know from single sites.

The five species classified as Data Deficient (DD) were included in this category due to their taxonomic uncertainty. According to Zona & al. (2007) and Jestrow & al. (2018), one of the greatest impediments to conservation assessments and action for Caribbean palms is the taxonomic confusion surrounding certain species, a problem that is not unique to the species of our region. Palms are a group that urgently needs molecular studies (phylogeny and population genetics) in order to elucidate the limits between species, as well as the relevance of subspecies, and the origin of hybrids. This problem is more evident in the two largest genera: *Coccothrinax* and *Copernicia*. Also, Zona & al. (2007) points out the necessity to carry out population genetic studies below the species level. Unfortunately, not many studies about this topic currently exist (Roncal & al. 2008, Jestrow & al. 2018).

The main threats reported in the present research are in concordance with those reported by other authors in the group (Zona & al. 2007, Rakotoarinivo & al. 2014). Also, invasive species, logging of associated species, and agriculture were reported by González-Torres & al. (2016) as some of the main threats to Cuban flora. Extreme precaution must be carried out with the species affected by climate change. According to Fuentes-Marrero & al. (2019), the mountain forests of eastern Cuba are very susceptible to these threats, and in some places the effects of drought and temperature increase are beginning to be noticed. Even when many species are inside protected areas, not all of these areas guarantee the same level of protection, as this depends on the management category and the socio-economic conditions that surround them.

Table 1. Plant formations, threats and distribution in protected areas of Cuban palm species. ER: Ecological Reserve, MFR: Managed Flora Reserve, NP: National Park, NOE: Natural Outstanding Element, NR: Natural Reserve, PAMR: Protected Area of Managed Resources, PL: Protected Landscape, WR: Wildlife Refuge.

Species	Plant Formations	Threats	Protected Areas
Acoelorrhaphe wrightii	Swamp forest	Felling	ER Los Indios
	Lowland pine forest	Fires	ER Los Pretiles
	Herbaceous formations of swamps and marshes	Habitat change and alteration	MFR Monte Ramonal
	Anthropic savannas	Intentional use	MFR San Ubaldo-Sabanalamar
	Seminatural savannas	Storms	NP Ciénaga de Zapata
			PAMR Península de Zapata
Acrocomia aculeata	Secondary forest	Agriculture	PL Maisí-Yumurí
	Mesophyllous semidecidous forest	Cattle	
	Secondary thicket	Felling of associated species	
	Anthropic savannas		
	Ruderal vegetation		
Acrocomia crispa	Gallery forest	Agriculture	ER Centro y oeste de Cayo Coco
	Secondary forest	Cattle	MFR Sabanas de Santa Clara
	Mesophyllous semidecidous forest	Habitat change and alteration	NP Ciénaga de Zapata
	Xeromorphic thorny thicket on serpentine	Invasive species	NP Desembarco del Granma
	Anthropic savannas		NP La Mensura-Pilotos
			PAMR Humedales del norte de Ciego de Ávila
			PAMR Península de Zapata
Bactris cubensis	Gallery forest	No threats	ER Maisí - Caleta
	Montane pine forest		MFR Cerro Miraflores
	Low altitude rainforest		NP Alejandro de Humboldt
	Montane rainforests		NP Pico Cristal
	Mogotes vegetation complex		NP Turquino
	Xeromorphic subthorny thicket on serpentine		PAMR Cuchillas del Toa
Calyptronoma plumeriana	Swamp forest	Drought	ER Lomas de Banao
	Gallery forest	Felling of associated species	MFR Sierra Preluda-Cuabales de Cajálbana
	Lowland pine forest		NOE Cañón del Yumurí
	Low altitude rainforest		NOE La Chucha
	Montane rainforests		NP Ciénaga de Zapata
	Mesophyllous evergreen forest		NP Pico La Bayamesa
	Mogotes vegetation complex		NP PN Caguanes
	Seminatural savannas		NP Turquino

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Species	Plant Formations	Threats	Protected Areas
			PAMR Buenavista
			PAMR Península de Zapata
			PAMR RB Baconao
			PL Topes de Collantes
Coccothrinax acunana	Montane rainforests	Climatic change	NP Pico La Bayamesa
			NP Turquino
Coccothrinax alexandri	Rocky coasts vegetation complex	Climatic change	ER Maisí - Caleta
	Coastal and subcoastal xeromorphic thicket	Felling	PAMR Cuchillas del Toa
	Xeromorphic subthorny thicket on serpentine	Habitat change and alteration	PL Maisí-Yumurí
		Storms	
		Urban-commercial-tourist areas	
Coccothrinax argentata	Microphyllous semidecidous forest	Climatic change	ER Bahía de Nuevas Grande - La Isleta
	Microphyllous evergreen forest	Diseases	ER Cayo Francés
	Sandy coasts vegetation complex	Felling of associated species	MFR Cayo Guajaba
	Rocky coasts vegetation complex	Intentional use	MFR Laguna Larga
	Secondary thicket	Invasive species	NP Caguanes
	Coastal and subcoastal xeromorphic thicket	Urban-commercial-tourist areas	NP Desembarco del Granma
			PAMR Buenavista
			PAMR Cayo Sabinal
			PAMR Humedales de Cayo Romano
			WR Ensenada del Gua y Cayos de Manzanillo
Coccothrinax baracoensis	Xeromorphic subthorny thicket on serpentine	Climatic change	PAMR Cuchillas del Toa
		Felling of associated species	
		Invasive species	
		Mining	
		Urban-commercial-tourist areas	
Coccothrinax bermudezii	Montane pine forest	Climatic change	Not inside protected areas
	Xeromorphic subthorny thicket on serpentine	Felling of associated species	
		Forestry activity	
Coccothrinax borhidiana	Microphyllous evergreen forest	Felling of associated species	Not inside protected areas

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Species	Plant Formations	Threats	Protected Areas
	Coastal and subcoastal xeromorphic thicket	Fires	
		Invasive species	
		Urban-commercial-tourist areas	
Coccothrinax camagueyana	Mesophyllous semidecidous forest	Unknown	ER Limones - Tuabaquey
			PAMR Sierra de Cubitas
Coccothrinax clarensis	Gallery forest	Felling of associated species	MFR Sabanas de Santa Clara
	Mesophyllous semidecidous forest	Forestry activity	
	Xeromorphic thorny thicket on serpentine	Mining	
	Anthropic savannas	Urban-commercial-tourist areas	
Coccothrinax crinita	Gallery forest	Agriculture	PL Topes de Collantes
	Mesophyllous semidecidous forest	Cattle	
	Secondary thicket	Fires	
	Xeromorphic thorny thicket on serpentine	Intentional use	
	Anthropic savannas	Invasive species	
Coccothrinax elegans	Mogotes vegetation complex	Climatic change	MFR Pozo Prieto
		Felling	PAMR Carso de Baire
Coccothrinax fagildei	Microphyllous semidecidous forest	No threats	ER Hatibonico
	Rocky coasts vegetation complex		PAMR RB Baconao
	Coastal and subcoastal xeromorphic thicket		
Coccothrinax fragrans	Coastal and subcoastal xeromorphic thicket	Cattle	PAMR RB Baconao
	Anthropic savannas	Felling of associated species	
		Invasive species	
		Urban-commercial-tourist areas	
		Agriculture	
Coccothrinax garciana	Gallery forest	Cattle	NR Cerro Galano
	Xeromorphic thorny thicket on serpentine	Climatic change	PL Bahía de Naranjo
	Anthropic savannas	Felling	
		Fires	
		Invasive species	
		Mining	

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Species	Plant Formations	Threats	Protected Areas
		Urban-commercial-tourist areas	
Coccothrinax gundlachii	Microphyllous evergreen forest	Agriculture	ER El Macío
	Coastal and subcoastal xeromorphic thicket	Cattle	
		Climatic change	
		Felling	
		Fires	
		Invasive species	
		Mining	
		Urban-commercial-tourist areas	
Coccothrinax hioramii	Microphyllous evergreen forest	Agriculture	ER Baitiquirí
	Coastal and subcoastal xeromorphic thicket	Cattle	ER Hatibonico
		Climatic change	MFR Sierra de la Canasta
		Felling of associated species	PAMR RB Baconao
		Intentional use	
		Invasive species	
		Urban-commercial-tourist areas	
Coccothrinax leonis	Microphyllous semidecidous forest	Agriculture	Not inside protected areas
	Secondary thicket	Cattle	
	Anthropic savannas	Invasive species	
Coccothrinax microphylla	Coastal and subcoastal xeromorphic thicket	Unknown	Not inside protected areas
Coccothrinax miraguama	Lowland pine forest	Agriculture	ER La Coca
	Montane pine forest	Cattle	ER Los Indios
	Mesophyllous semidecidous forest	Climatic change	ER Sierra de Guane - Paso Real de Guane
	Microphyllous semidecidous forest	Felling	MFR Lomas de Galindo
	Microphyllous evergreen forest	Felling of associated species	MFR San Ubaldo-Sabanalamar
	Mogotes vegetation complex	Fires	NP Ciénaga de Zapata
	Secondary thicket	Habitat change and alteration	NP Viñales
	Coastal and subcoastal xeromorphic thicket	Invasive species	PAMR Península de Guanahacabibes
	Xeromorphic thorny thicket on serpentine	Urban-commercial-tourist areas	PAMR Península de Zapata

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Species	Plant Formations	Threats	Protected Areas
	Anthropic savannas		PAMR Sierra de la Cañada
	Seminatural savannas		PAMR Valle de Yaguanabo
			PL Topes de Collantes
			WR Río Máximo
Coccothrinax munizii	Coastal and subcoastal xeromorphic thicket	Climatic change	ER Baitiquirí
		Storms	
Coccothrinax muricata	Mesophyllous semidecidous forest	Climatic change	ER Limones - Tuabaquey
	Mogotes vegetation complex	Felling	PAMR Sierra de Cubitas
		Invasive species	PAMR Sierra del Chorrillo
			PL Sierra de Najasa
Coccothrinax orientalis	Montane pine forest	Climatic change	MFR Cerro Miraflores
	Xeromorphic subthorny thicket on serpentine	Felling of associated species	NP Alejandro de Humboldt
		Fires	NP Pico Cristal
		Forestry activity	
		Invasive species	
		Mining	
		Urban-commercial-tourist areas	
Coccothrinax pauciramosa	Montane pine forest	Agriculture	Not inside protected areas
	Xeromorphic subthorny thicket on serpentine	Felling of associated species	
		Fires	
		Forestry activity	
		Invasive species	
		Mining	
Coccothrinax pseudorigida	Secondary thicket	Cattle	Not inside protected areas
	Xeromorphic thorny thicket on serpentine	Climatic change	
	Anthropic savannas	Felling of associated species	
		Fires	
		Forestry activity	
		Invasive species	
		Mining	
		Urban-commercial-tourist areas	

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Species	Plant Formations	Threats	Protected Areas
Coccothrinax rigida	Mogotes vegetation complex	No threats	PAMR Cuchillas del Toa
Coccothrinax salvatoris	Microphyllous evergreen forest	Agriculture	NOE Cerros Cársicos de Maniabón
	Mogotes vegetation complex	Invasive species	PAMR Buenavista
	Coastal and subcoastal xeromorphic thicket		PAMR Cayo Sabinal
	Xeromorphic thorny thicket on serpentine		WR Bahía de Malagueta
			WR Cayos Los Ballenatos y manglares de la bahía de Nuevitas
Coccothrinax savannarum	Mogotes vegetation complex	Felling of associated species	NP La Mensura-Pilotos
Coccothrinax saxicola	Coastal and subcoastal xeromorphic thicket	No threats	NP Desembarco del Granma
Coccothrinax spirituana	Xeromorphic thorny thicket on serpentine	Agriculture	Not inside protected areas
		Cattle	
		Forestry activity	
		Invasive species	
Coccothrinax torrida	Coastal and subcoastal xeromorphic thicket	No threats	ER Tacre
Coccothrinax trinitensis	Mogotes vegetation complex	Climatic change	ER Pico San Juan
		Felling	PL Topes de Collantes
		Invasive species	
Coccothrinax yunquensis	Mogotes vegetation complex	Climatic change	NOE Yunque de Baracoa
			PAMR Cuchillas del Toa
Coccothrinax yuraguana	Montane pine forest	Felling	MFR Sierra Preluda-Cuabales de Cajálbana
	Xeromorphic thorny thicket on serpentine	Felling of associated species	
		Fires	
		Forestry activity	
Colpothrinax wrightii	Lowland pine forest	Agriculture	ER Los Indios
	Herbaceous formations of swamps and marshes	Cattle	MFR San Ubaldo-Sabanalamar
	Seminatural savannas	Felling of associated species	
		Fires	
		Invasive species	
Copernicia baileyana	Mesophyllous semidecidous forest	Agriculture	WR Delta del Agabama
	Anthropic savannas	Intentional use	WR Delta del Cauto
		Invasive species	WR Ojo de Agua
Copernicia brittoniorum	Microphyllous semidecidous forest	Cattle	NOE Sistema Espelolacustre de Zapata
	Microphyllous evergreen forest	Felling	NP Ciénaga de Zapata

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Species	Plant Formations	Threats	Protected Areas
	Secondary thicket	Felling of associated species	PAMR Península de Zapata
	Coastal and subcoastal xeromorphic thicket	Fires	
		Invasive species	
Copernicia cowellii	Xeromorphic thorny thicket on serpentine	Felling of associated species	Not inside protected áreas
		Fires	
		Invasive species	
		Mining	
		Urban-commercial-tourist areas	
Copernicia curbeloi	Mesophyllous semidecidous forest	Agriculture	Not inside protected areas
	Anthropic savannas	Cattle	
		Habitat change and alteration	
		Invasive species	
		Urban-commercial-tourist areas	
Copernicia curtissii	Mangrove forest	Agriculture	ER Los Indios
	Lowland pine forest	Cattle	NP Viñales
	Anthropic savannas	Fires	
	Seminatural savannas	Forestry activity	
		Invasive species	
		Mining	
Copernicia fallaensis	Mesophyllous semidecidous forest	Agriculture	WR Macurije-Santa Maria
	Secondary thicket	Diseases	
	Anthropic savannas	Felling	
		Felling of associated species	
		Fires	
Copernicia gigas	Swamp forest	Agriculture	NP Caguanes
	Microphyllous semidecidous forest	Cattle	PAMR Buenavista
	Anthropic savannas	Felling of associated species	PAMR Humedales del norte de Ciego de Avila
	Seminatural savannas	Invasive species	WR Delta del Cauto
			WR Sistema Lagunar La leche - La Redonda
Copernicia glabrescens	Swamp forest	Agriculture	MFR San Ubaldo-Sabanalamar
	Lowland pine forest	Cattle	MFR Sierra Preluda-Cuabales de Cajálbana

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Species	Plant Formations	Threats	Protected Areas
	Mesophyllous semidecidous forest	Forestry activity	NP Guanahacabibes
	Sandy coasts vegetation complex	Mining	PAMR Península de Guanahacabibes
	Rocky coasts vegetation complex		
	Coastal and subcoastal xeromorphic thicket		
	Xeromorphic thorny thicket on serpentine		
	Seminatural savannas		
Copernicia hospita	Xeromorphic thorny thicket on serpentine	Agriculture	Not inside protected áreas
	Anthropic savannas	Intentional use	
		Invasive species	
		Urban-commercial-tourist areas	
Copernicia humicola	Microphyllous semidecidous forest	Unknown	Not inside protected áreas
Copernicia longiglossa	Microphyllous semidecidous forest	Cattle	Not inside protected areas
Copernicia macroglossa	Sandy coasts vegetation complex	Agriculture	MFR Monte Ramonal
	Coastal and subcoastal xeromorphic thicket	Cattle	NP Jardines de la Reina
	Xeromorphic thorny thicket on serpentine	Felling of associated species	WR Delta del Agabama
	Anthropic savannas	Fires	
		Intentional use	
		Invasive species	
Copernicia rigida	Microphyllous semidecidous forest	Agriculture	ER Bahía de Nuevas Grande - La Isleta
	Secondary thicket	Cattle	MFR Cerro Miraflores
	Xeromorphic thorny thicket on serpentine	Felling	NP Alejandro de Humboldt
	Xeromorphic subthorny thicket on serpentine	Felling of associated species	NP Caguanes
	Anthropic savannas	Invasive species	PAMR Buenavista
			PAMR Cuchillas del Toa
			WR Delta del Cauto
			WR Río Máximo
Copernicia roigii	Microphyllous evergreen forest	Unknown	NP Turquino
	Coastal and subcoastal xeromorphic thicket		WR Bahía de Malagueta
	Anthropic savannas		
Copernicia yarey	Swamp forest	Agriculture	ER Centro Y Oeste de Cayo Coco
	Gallery forest	Cattle	MFR Cayo Guajaba

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Species	Plant Formations	Threats	Protected Areas
	Mangrove forest	Felling	MFR Cerro Miraflores
	Microphyllous evergreen forest	Habitat change and alteration	NP Alejandro de Humboldt
	Sandy coasts vegetation complex		PAMR Buenavista
	Coastal and subcoastal xeromorphic thicket		PAMR Cuchillas del Toa
	Xeromorphic thorny thicket on serpentine		PAMR Humedales del norte de Ciego de Avila
	Xeromorphic subthorny thicket on serpentine		PAMR RB Baconao
	Anthropic savannas		WR Cayo Santa María
			WR Cayos Los Ballenatos y manglares de la bahía de Nuevitas
			WR Delta del Cauto
Gaussia princeps	Mogotes vegetation complex	No threats	ER Sierra de Guane - Paso Real de Guane
			NOE Sierra del Pesquero - Mesa-Sumidero
Gaussia spirituana	Mogotes vegetation complex	Agriculture	PAMR Buenavista
		Fires	PAMR Jobo Rosado
		Mining	
		Storms	
		Urban-commercial-tourist areas	
Hemithrinax compacta	Mogotes vegetation complex	Felling of associated species	NP La Mensura-Pilotos
		Habitat change and alteration	
Hemithrinax ekmaniana	Mogotes vegetation complex	No threats	Not inside protected areas
Hemithrinax rivularis	Gallery forest	Drought	MFR Cerro Miraflores
	Xeromorphic subthorny thicket on serpentine	Felling of associated species	NP Alejandro de Humboldt
		Forestry activity	PAMR Cuchillas del Toa
		Habitat change and alteration	
		Mining	
Leucothrinax morrisii	Mesophyllous semidecidous forest	Fires	ER Sierra de Guane - Paso Real de Guane
	Microphyllous evergreen forest	Habitat change and alteration	ER Sierra la Guira
	Mogotes vegetation complex	Invasive species	MFR Laguna Larga
			MFR Loma del Grillo
			NOE Sierra del Pesquero - Mesa-Sumidero
			NP Viñales
			PAMR Cayo Sabinal

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Species	Plant Formations	Threats	Protected Areas
			PAMR Humedales de Cayo Romano
			PAMR Mil Cumbres
			PAMR Península de Guanahacabibes
			PL Escaleras de Jaruco
			WR Cayos Los Ballenatos y manglares de la bahía de Nuevitas
Prestoea acuminata	Low altitude rainforest	No threats	ER Loma del Gato - Monte Líbano
	Montane rainforests		NOE Yunque de Baracoa
			NP Pico La Bayamesa
			NP Turquino
			PAMR Cuchillas del Toa
			PAMR RB Baconao
			PL Gran Piedra
Pseudophoenix sargentii	Microphyllous evergreen forest	Felling of associated species	ER Centro Y Oeste de Cayo Coco
	Sandy coasts vegetation complex	Urban-commercial-tourist areas	MFR Cayo Guajaba
	Coastal and subcoastal xeromorphic thicket		PAMR Buenavista
			PAMR Humedales de Cayo Romano
			PAMR Humedales del norte de Ciego de Avila
			PL Maisí-Yumurí
			WR Bahía de Malagueta
Roystonea lenis	Gallery forest	Agriculture	PL Maisí-Yumurí
	Low altitude rainforest	Forestry activity	
	Mesophyllous semidecidous forest	Habitat change and alteration	
	Segetal vegetation	Intentional use	
Roystonea maisiana	Mesophyllous semidecidous forest	Agriculture	PL Maisí-Yumurí
	Anthropic savannas	Cattle	
	Segetal vegetation	Felling of associated species	
		Invasive species	
Roystonea regia	Gallery forest	Agriculture	ER Cayo Mono-Galindo
	Low altitude rainforest	Cattle	ER Centro Y Oeste de Cayo Coco
	Montane rainforests	Invasive species	ER El Salón
	Secondary forest		ER La Coca

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Species	Plant Formations	Threats	Protected Areas
	Mesophyllous semidecidous forest		ER Lomas de Banao
	Mesophyllous evergreen forest		ER Pico Caracas
	Mogotes vegetation complex		ER Pico Mogote
	Anthropic savannas		ER Sierra de Guane - Paso Real de Guane
	Seminatural savannas		ER Sierra la Guira
			MFR Laguna Larga
			MFR Monte Ramonal
			MFR Sabanas de Santa Clara
			MFR Sierra Contadores - Cayo Ratones
			MFR Sierra Preluda-Cuabales de Cajálbana
			NOE Cañón del Yumurí
			NOE Punte Bitiri
			NOE Yunque de Baracoa
			NP Alejandro de Humboldt
			NP Desembarco del Granma
			NP La Mensura-Pilotos
			NP Pico La Bayamesa
			NP Turquino
			NP Viñales
			PAMR Buenavista
			PAMR Cayo Sabinal
			PAMR Cuchillas del Toa
			PAMR Humedales del norte de Ciego de Ávila
			PAMR Mil Cumbres
			PAMR Península de Guanahacabibes
			PAMR Península de Zapata
			PAMR RB Baconao
			PAMR RB Sierra del Rosario
			PAMR Sierra de la Cañada
			PL Bahía de Naranjo
			PL Gran Piedra
			PL Isla Josefina

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Species	Plant Formations	Threats	Protected Areas
			PL Maisí-Yumurí
			PL Topes de Collantes
			WR Bahía de Malagueta
Roystonea stellata		Extinct	
Roystonea violacea	Gallery forest	Agriculture	Not inside protected areas
	Mesophyllous semidecidous forest	Cattle	
	Anthropic savannas	Drought	
	Segetal vegetation	Felling	
		Habitat change and alteration	
Sabal domingensis	Gallery forest	Agriculture	MFR Macambo
	Mesophyllous semidecidous forest	Cattle	
	Anthropic savannas	Felling of associated species	
		Urban-commercial-tourist areas	
Sabal maritima	Swamp forest	Agriculture	MFR Cerro Miraflores
	Mesophyllous semidecidous forest	Cattle	NOE Sistema Espelolacustre de Zapata
	Sandy coasts vegetation complex	Forestry activity	NP Ciénaga de Zapata
	Herbaceous formations of swamps and marshes	Urban-commercial-tourist areas	NP Desembarco del Granma
	Coastal and subcoastal xeromorphic thicket		NP Guanahacabibes
	Anthropic savannas		PAMR Buenavista
	Seminatural savannas		PAMR Península de Guanahacabibes
	Ruderal vegetation		PAMR Península de Zapata
			PL Bahía de Naranjo
			WR Bahía de Malagueta
			WR Río Máximo
Sabal palmetto	Microphyllous evergreen forest	Habitat change and alteration	NP Ciénaga de Zapata
	Sandy coasts vegetation complex	Urban-commercial-tourist areas	PAMR Península de Zapata
	Rocky coasts vegetation complex		
	Coastal and subcoastal xeromorphic thicket		
	Anthropic savannas		
Sabal yapa	Mesophyllous semidecidous forest	Felling of associated species	NP Ciénaga de Zapata

Table 1. Plant formations, threats and distribution in protected areas of Cuban palm species. ER: Ecological Reserve, MFR: Managed Flora Reserve, NP: National Park, NOE: Natural Outstanding Element, NR: Natural Reserve, PAMR: Protected Area of Managed Resources, PL: Protected Landscape, WR: Wildlife Refuge.

Species	Plant Formations	Threats	Protected Areas
	Rocky coasts vegetation complex	Fires	NP Guanahacabibes
	Mogotes vegetation complex	Habitat change and alteration	PAMR Península de Guanahacabibes
	Coastal and subcoastal xeromorphic thicket		PAMR Península de Zapata
			PAMR Sur de la Isla de la Juventud
Thrinax radiata	Microphyllous semidecidous forest	Habitat change and alteration	ER Cayo Largo
	Sandy coasts vegetation complex	Urban-commercial-tourist areas	MFR Laguna Larga
	Rocky coasts vegetation complex		NOE Pan de Guajaibón
	Coastal and subcoastal xeromorphic thicket		NOE Sistema Espelolacustre de Zapata
			NP Desembarco del Granma
			NP Guanahacabibes
			NP Punta Francés
			PAMR Buenavista
			PAMR Cayo Sabinal
			PAMR Cuchillas del Toa
			PAMR Humedales de Cayo Romano
			PAMR Humedales del norte de Ciego de Ávila
			PAMR Mil Cumbres
			PAMR Península de Guanahacabibes
			PAMR Península de Zapata
			PAMR RB Baconao
			PAMR Sur de la Isla de la Juventud
			PL Bahía de Naranjo
			WR Bahía de Tánamo y Cayos
			WR Cayo Campos - Cayo Rosario

Table 2. Conservation status of Cuban palm species

Endemic species are marked with an asterisk (*). AOO: Extent of occurrence, AOO: area of occupancy (% inside protected areas). Localities were defined according to IUCN standards; when the definition of localities does not apply, they are indicated with a dash (-). EX: Extinct, CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near Threatened, LC: Least Concern, DD: Data Deficient.

Especie	EOO km²	AOO km² (% in PA)	Localities	Category – Criteria
Acoelorrhaphe wrightii (Griseb. & H. Wendl.) H. Wendl. ex Becc.	105 206	18 (38.9 %)	18	LC
Acrocomia aculeata (Jacq.) Lodd. ex Mart.	23 510	8 (12.5 %)	-	LC
Acrocomia crispa (Kunth) C. F. Baker ex Becc.*	147 959	34 (14.7 %)	23	LC
Bactris cubensis Burret*	9 381	17 (70.6 %)	-	LC
Calyptrogyne plumeriana (Mart.) Lourteig.*	138 205	32 (31.3 %)	-	LC
Coccothrinax acunana León*	3.4	3 (100 %)	-	VU D1+2
Coccothrinax alexandri León*	1 528	9 (55.6 %)	9	VU B1ab(iii,v)+2ab(iii,v)
Coccothrinax argentata (Jacq.) Bailey	72 331	18 (50 %)	16	LC
Coccothrinax baracoensis Borhidi & O. Muñiz*	0	1 (100 %)	1	CR B1ab(i,ii,iii,v)+2ab(i,ii,iii,v)
Coccothrinax bermudezii León*	0	1 (0 %)	1	CR B1ab(ii,iii,v)+2ab(ii,iii,v)
Coccothrinax borhidiana O. Muñiz*	0	1 (0 %)	1	CR A4ace;B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)
Coccothrinax camagueyana Borhidi & O. Muñiz*	0	1 (100 %)	1	DD
Coccothrinax clarensis León*	1 332	8 (37.5 %)	6	VU B1ab(iii,v)+2ab(iii,v)
Coccothrinax crinita (Griseb. & Wendl. ex C. Wright) Becc.*	800	3 (33.3 %)	3	CR B2ab(iii,v)
Coccothrinax elegans O. Muñiz & Borhidi*	99	4 (25 %)	4	EN B1ab(v)+2ab(v)
Coccothrinax fagildei Borhidi & O. Muñiz*	79	4 (100 %)	-	VU D1
Coccothrinax fragrans Burret	0	2 (50 %)	2	EN B1ab(iii,v)+2ab(iii,v)
Coccothrinax garciana León*	627	14 (14.3 %)	14	LC
Coccothrinax gundlachii León*	748	7 (14.3 %)	4	EN B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)
Coccothrinax hioramii León*	704	8 (50 %)	8	VU B1ab(iii,v)+2ab(iii,v)
Coccothrinax leonis O. Muñiz & Borhidi*	0	1 (0 %)	1	CR B1ab(ii,iii,v)+2ab(ii,iii,v)
Coccothrinax microphylla Borhidi & O. Muñiz*	0	1 (0 %)	1	DD
Coccothrinax miraguama (Kunth) Becc.*	106 647	45 (33.3 %)	-	LC
Coccothrinax munizii Borhidi*	59	3 (33.3 %)	-	LC
Coccothrinax muricata León*	588	5 (80 %)	2	EN B1ab(iii,v)+2ab(iii,v)
Coccothrinax orientalis (León) O. Muñiz & Borhidi*	1 741	9 (44.4 %)	9	VU B1ab(ii,iii,v)+2ab(ii,iii,v)
Coccothrinax pauciramosa Burret*	13	3 (0 %)	2	CR B1ab(ii,iii,v)+2ab(ii,iii,v)
Coccothrinax pseudorigida León*	551	5 (0 %)	5	EN B1ab(ii,iii,v)+2ab(ii,iii,v)
Coccothrinax rigida (Griseb. & Wendl.) Becc.*	132	3 (33.3 %)	-	LC
Coccothrinax salvatoris León*	7 438	9 (55.5 %)	-	LC

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Especie	EOO km²	AOO km² (% in PA)	Localities	Category – Criteria
Coccothrinax savannarum (León) O. Muñiz & Borhidi*	0	2 (50 %)	-	LC
Coccothrinax saxicola León*	0	1 (100 %)	-	LC
Coccothrinax spirituana Verdecia & Moya*	0	1 (0 %)	1	CR B1ab(iii,v)+2ab(iii,v)
Coccothrinax torrida Morici & Verdecia*	0	1 (100 %)	-	LC
Coccothrinax trinitensis Borhidi & O. Muñiz*	96.527	7 (57.1 %)	6	VU B1ab(v)+2ab(v);D1
Coccothrinax yunquensis Borhidi & O. Muñiz*	0	1 (100 %)	-	EN D
Coccothrinax yuraguana (A. Rich.) León*	0	2 (50 %)	1	CR B1ab(ii,iii,v)+2ab(ii,iii,v)
Colpothrinax wrightii Griseb. & H. Wendl. ex Voss*	13 742	16 (12.5 %)	8	VU B1ab(iii,v)+2ab(iii,v)
Copernicia baileyana León*	42 074	43 (9.3 %)	-	LC
Copernicia brittonorum León*	7 605	10 (20 %)	6	VU B2ab(ii,iii,v)+2ab(ii,iii,v)
Copernicia cowellii Britton & P. Wilson*	3 867	14 (0 %)	5	EN B1ab(ii,iii,v)+2ab(ii,iii,v)
Copernicia curbeloi León*	10 141	14 (0 %)	10	VU B1ab(iii,v)+2ab(iii,v)
Copernicia curtissii Becc.*	12 945	14 (14.3 %)	-	LC
Copernicia fallaensis León*	49 56	11 (9.1 %)	5	EN B1ab(ii,iii,v)+2ab(ii,iii,v);C2a(i)
Copernicia gigas Ekman ex Burret*	29 859	23 (13.04 %)	-	LC
Copernicia glabrescens H. Wendl. ex Becc.*	20 482	30 (23.3 %)	-	LC
Copernicia hospita Mart.*	27 533	31 (0 %)	-	LC
Copernicia humicola León*	0	1 (0 %)	-	DD
Copernicia longiglossa León*	0	1 (0 %)	1	DD
Copernicia macroglossa H. Wendl. ex Becc.*	48 892	22 (13.6 %)	23	LC
Copernicia rigida Britton & P. Wilson*	45 727	35 (22.9 %)	34	LC
Copernicia roigii León*	11 460	10 (20 %)	10	DD
Copernicia yarey Burret*	37 836	22 (40.9 %)	24	LC
Gaussia princeps H. Wendl.*	519	3 (66.7 %)	-	LC
Gaussia spirituana Moya & Leiva*	78	4 (50 %)	3	EN B1ab(ii,iii,v)+2ab(ii,iii,v);D
Hemithrinax compacta (Griseb. & Wendl.) M. Gómez*	60	5 (60 %)	4	EN B1ab(iii)+2ab(iii)
Hemithrinax ekmaniana Burret*	0	1 (0 %)	1	VU D1
Hemithrinax rivularis León*	702	6 (100 %)	5	EN B1ab(ii,iii,v)+2ab(ii,iii,v)
Leucothrinax morrisii (H. Wendl.) C. Lewis & Zona*	76 388	22 (50 %)	-	LC
Prestoea acuminata subsp. *montana* (Graham) Greuter & R. Rankin*	5 790	9 (88.9 %)	-	LC

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Especie	EOO km²	AOO km² (% in PA)	Locali-ties	Category – Criteria
Pseudophoenix sargentii H. Wendl. ex Sarg.*	20 149	14 (71.4 %)	14	LC
Roystonea lenis León*	1 463	4 (25 %)	3	CR B2ab(iii,v)
Roystonea maisiana (L. H. Bailey) Zona*	49	4 (25 %)	1	CR B1ab(i,ii,iii,v)+2ab(i,ii,iii,v)
Roystonea regia (Kunth) O. F. Cook*	193 730	83 (60.2 %)	-	LC
Roystonea stellata León*	-	-	0	EX
Roystonea violacea León*	230	12 (0 %)	1	CR B2ab(iii)
Sabal domingensis Becc.*	303	6 (16.7 %)	4	EN B1ab(iii)+2ab(iii)
Sabal maritima (Kunth) Burret*	177 541	33 (27.3 %)	-	LC
Sabal palmetto (Walter) Lodd. ex Schult. & Schult. f.*	33 045	10 (10 %)	9	VU B2ab(iii,v)
Sabal yapa C. Wright ex Becc.*	27 931	10 (40 %)	7	VU B2ab(iii,v)
Thrinax radiata Lodd. ex Schult. & Schult. f.*	191 793	34 (52.9 %)	-	LC

The legal framework that they ensure allows implementation of more effective recovery and management measures. In this sense, protected areas are core tools for global and local biodiversity conservation strategies and play an important part in buffering negative anthropogenic effects on biodiversity.

In the future, we need to be more focused on the conservation of Cuban palms. The proposition and implementation of conservation plans, specifically designed for each species, are necessary if we want to ensure the long-term protection of these plants. Also, it is vital to include in the conservation plans the local communities, local and national governments, and other stakeholders, in order to implement more effective conservation actions.

CONCLUSIONS

Cuban palms stand out for their importance as a cornerstone of Caribbean biodiversity, a group characterized by high levels of endemism and taxonomic diversity. However, more than 50% of the species assessed are threatened, with the *Coccothrinax* genus being the most affected. The main threats include invasive species, agricultural activities, logging of associated species, and climate change. Particularly concerning is the status of microendemic species, many of which are not protected within the National System of Protected Areas. Despite progress in conservation assessments, such as updates aligned with IUCN criteria, significant challenges remain. These include the urgent need for molecular studies to resolve taxonomic uncertainties and accurately delineate species boundaries. We highlight the need to implement specific conservation plans that combine *in situ* and *ex situ* strategies, while emphasizing the importance of engaging local communities, government agencies, and other stakeholders to promote more effective conservation actions. Ensuring the long-term survival of Cuban palms and their ecosystems requires an integrated approach that addresses both biological and socioeconomic factors.

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